EFFECTS OF DUSTING ON PLUMAGE OF JAPANESE QUAIL

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Many authorities have suggested that dust-bathing by birds helps control ectoparasites and promotes cleanliness. However experimental verification of these ideas is meager, and the importance of dusting sites is sometimes questioned by wildlife habitat managers. We noticed that Japanese Quail (*Coturnix c. japonica*) maintained a fairly constant daily level of dusting even when they were free of ectoparasites. This made us wonder if the dusting behavior merited more attention in wildlife habitat studies, and we designed an experiment to determine some of the effects of dusting on plumage condition.

The dusting patterns of Japanese Quail, described by Benson (1965), consist of a series of stereotyped movements that function to place dust particles on the plumage. *Coturnix* appear to perform complete dusting patterns without previous experience. They will dust on solid surfaces, but particulate surfaces elicit more dusting behavior. Visual clues are more important than tactile clues in stimulating dusting, and birds rarely attempt to dust on ½-inch mesh wire screen.

Dusting has been reported for many gallinaceous birds, including Ruffed Grouse (*Bonasa umbellus*) (Bump et al., 1947, Hein, 1970); Bobwhite (*Colinus virginianus*) (Stoddard, 1931); Scaled Quail (*Callipepla squamata*) (Wallmo, 1956); Ring-necked Pheasant (*Phasianus colchicus*) (Ginn 1962); Chukar Partridge, (*Alectoris chukar*) (Bohl, 1957); and Turkey (*Meleagris gallopavo*) (Bailey and Rinell, 1967; Mosby and Handley, 1943; Schorger, 1966; Wheeler, 1948). Ant beds, ashes, and rotted wood were most frequently listed as dusting sites, but animal burrows, road beds, and open places were also mentioned.

Stoddard (1931:315) reported that lice multiplied rapidly on Bobwhite kept in shipping crates and prevented from dusting, but no other documentation of the idea that dusting promoted cleanliness or controlled parasites was found. Schorger (1966:177) in his book on turkeys states, "There is no proof for any of the reasons advanced for dusting. . ."

METHODS

Eighty 6-week-old Japanese quail were obtained from a colony belonging to the West Virginia University Biology Department. Before the experiment, they were kept in cages holding over 100 birds. The room temperature had been held constant at 85°F, and the quail had received 15 hours of light per day.

During the experiment, the birds were kept in individual cages, and the room temper-

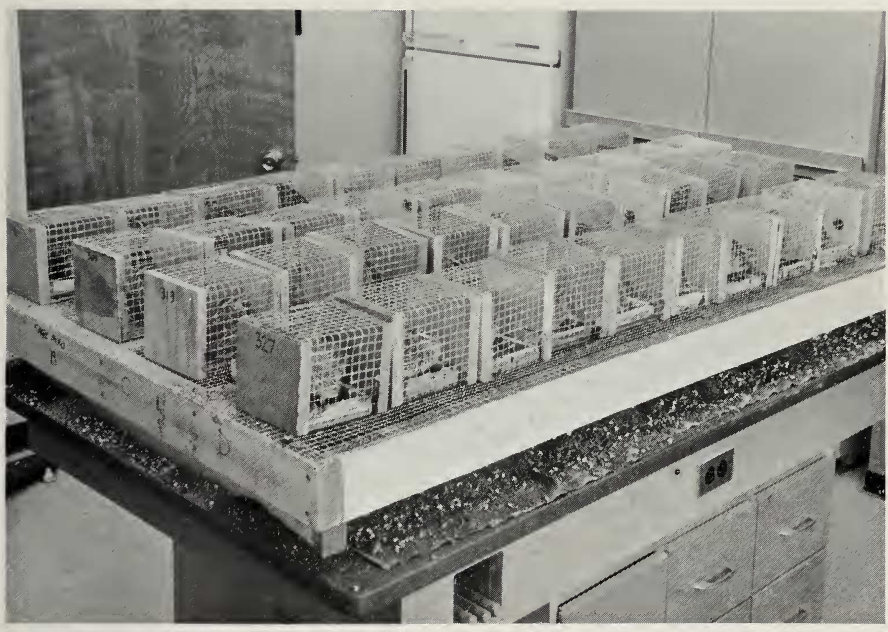

Fig. 1. Arrangement of individual cages on the wire platform.

ature was held at 78°F. The birds were exposed to natural day length, which increased from 12.5 hours (27 March) to 13.8 hours (24 April).

The individual cages had internal dimensions of 5 × 5 × 5 inches. Two sides of the cage were made of boards; the top and other two sides with ½-inch mesh wire screen. The bottom was left open to accommodate a 5 × 5-inch wooden tray which held dusting material. The cages were set in rows on a ½-inch mesh wire screen platform (Fig. 1). This arrangement kept the birds physically isolated, gave them access to food and water, and allowed us to give dusting material to individual birds. Feed and water were supplied ad lib. The feed was turkey starter mash with 1 pound of grit added to each 10 pounds of mash.

The experimental treatment consisted of allowing 40 birds (23 males, 17 females) to dust at will for 17 days. Another 40 birds (15 males, 25 females) were kept as controls, and before and after comparisons were made for sample feathers from both groups.

The birds were put into the experimental cages on 27 March and kept there for a 14-day acclimatization period. At the end of this period (8 April), three feathers were plucked from the right side of each bird (Fig. 2). The feathers were the second primary (wing), a tail feather, and a feather from the center of the ventral tract (breast).

On 9 April, trays filled with dust were placed in half of the cages. The dusting trays were left in the cages continuously for the next 17 days, except for daily cleaning and filling with dust. The dust came from local topsoil, described as a sandy loam of the Monongahela series (Van Eck, 1968), that had been ovendried and sifted through a 0.0787-inch mesh soil sieve.

On 24 April, the dusting trays were removed and a second set of feathers was taken

Fig. 2. Sample feathers from bird 340. Left, feathers taken before dusting. Right, feathers taken after dusting.

from the left side of each bird for comparison with the first set. Sample feathers were examined under a binocular microscope at 13-power magnification and evaluated for two criteria: alignment of barbs and presence of dandruff. Barb alignment is maintained by the overlapping of many hooked barbules which originate from each barb. In a well-groomed feather, the parallel barbs are held together in flat webs, and there are no gaps between individual barbs. The feathers on the left side of Figure 2 show non-alignment of barbs in contrast to the aligned barbs of the feathers on the right side of the figure. Dandruff consisted of particles of feather shaft and bits of skin. Dandruff was visible to the unaided eye, and the particles were easily counted at 13-power magnification. Feather dandruff and barb alignment were judged independently.

The "after" feather was compared to the "before" feather for each bird (wing against wing, breast against breast, tail against tail). Each feather was scored +1 for improvement, 0 for no change, or –1 for a decline. The three scores were then added, so the possible score for each criteria ranged from +3 to –3.

RESULTS

Dusting improved feather barb alignment and reduced dandruff. In the before-and-after comparison, 62 percent of the dusting birds showed better feather barb alignment, compared to 15 percent of the control birds. Reduction of dandruff showed on 85 percent of the dusting birds but on only 8 percent of the controls. Feather condition of most of the control birds remained the same or deteriorated.

There were 10 possible ways in which a bird could show either improvement or decline, and 7 ways a bird could show no change (Table 1). Most of these possible score combinations occurred, but the changes in wing, breast, and tail feathers were not independent. In general, all three sample feathers

TABLE 1

FEATHER BARB ALIGNMENT AND DANDRUFF SCORES FOR WING, BREAST AND TAIL FEATHERS OF JAPANESE QUAIL KEPT ON WIRE OR ALLOWED TO DUST, AND NUMBER OF BIRDS WITH EACH SCORE[1]

Sets of Scores Possible for Each Bird				Birds Receiving Each Score			
				Alignment		Dandruff	
Wing	Breast	Tail	Total	Dust	Wire	Dust	Wire
Net decline scores							
−1	−1	−1	−3	—	1	—	—
−1	−1	0	−2	1	2	—	1
−1	0	−1	−2	1	5	—	—
0	−1	−1	−2	—	2	1	2
−1	0	0	−1	—	7	—	2
0	−1	0	−1	—	1	—	6
0	0	−1	−1	1	—	—	6
+1	−1	−1	−1	—	—	—	—
−1	+1	−1	−1	—	1	—	—
−1	−1	+1	−1	—	1	—	—
				3	20	1	17
No net change scores							
0	0	0	0	4	7	3	20
+1	−1	0	0	—	—	—	—
+1	0	−1	0	—	1	2	—
0	+1	−1	0	2	1	—	—
−1	+1	0	0	3	3	—	—
−1	0	+1	0	2	2	—	—
0	−1	+1	0	1	—	—	—
				12	14	5	20
Net improvement scores							
+1	0	0	+1	1	—	2	—
0	+1	0	+1	4	1	—	1
0	0	+1	+1	4	2	4	1
+1	−1	+1	+1	1	—	—	—
+1	+1	−1	+1	2	—	—	—
−1	+1	+1	+1	2	1	—	—
+1	+1	0	+2	—	1	2	—
+1	0	+1	+2	—	—	4	—
0	+1	+1	+2	9	1	7	—
+1	+1	+1	+3	2	—	15	1
				25	6	34	3

[1] All possible sets of scores, wing + breast + tail, are shown in the four left-most columns. The number of quail receiving each score is shown in the columns on the right.

TABLE 2

CHANGES IN THE AMOUNT OF DANDRUFF ON WING, BREAST, AND TAIL FEATHERS OF 40 JAPANESE QUAIL KEPT ON WIRE OR ALLOWED TO DUST

	Number of Sample Feathers					
	With Dust			Without Dust		
Feathers	More	No Change	Less	More	No Change	Less
Wing	0	15	25	3	36	1
Breast	1	15	24	9	29	2
Tail	3	7	30	8	30	2

for each bird changed in the same direction. For example, without dust, 36 birds received a 0 score (no change) for dandruff on the wing feather. Of these 36 birds, 27 also received a 0 score for dandruff on both the breast and tail feathers. Fifteen of the birds allowed to dust had a reduction in dandruff on all three sample feathers.

Considering the three types of feathers independently, dusting decreased dandruff on most feathers (25 wing, 24 breast, and 30 tail feathers from dusting birds had a decrease in dandruff). Most of the feathers from the control birds showed no change in the amount of dandruff (Table 2).

In barb alignment, the three types of feathers did not respond uniformly to dusting. With dusting, breast and tail feathers generally improved in barb alignment (24 and 21 out of 40, respectively) while only 6 out of 40 wing feathers showed any improvement. Without dust, barb alignment of wing feathers definitely deterioriated (23 out of 40) while most of the breast and tail feathers remained unchanged (Table 3).

DISCUSSION

Birds with dusting trays dusted frequently and usually responded immediately when fresh dust was added. Dusting behavior patterns were complete

TABLE 3

CHANGES IN THE CONDITION OF BARB ALIGNMENT FOR WING, BREAST, AND TAIL FEATHERS OF 40 JAPANESE QUAIL KEPT ON WIRE OR ALLOWED TO DUST

	Number of Sample Feathers					
	With Dust			Without Dust		
Feathers	Worse	No Change	Better	Worse	No Change	Better
Wing	9	25	6	23	15	2
Breast	3	13	24	7	24	9
Tail	6	13	21	11	22	7

and typical for *Coturnix*. In a few instances, birds on wire tried to dust. This occurred when several nearby birds with dusting material were dusting.

Mechanical injury in the small cages probably accounted for the decrease in wing barb alignment of non-dusting birds. The improvement in breast and tail feather characteristics of dusting birds was an effect of dusting.

The general appearance of dusting birds was improved. The most noticeable effect of dusting was a reduction in oil or moisture content of the plumage. Down feathers and downy barbs at the base of contour feathers were dry and fluffy, so that down filled the space between the contour feathers and the bird's skin. Birds kept on wire appeared greasy, in comparison to dusting birds. The down was matted and the skin could be seen easily by parting contour feathers.

The common method of cleaning and drying bird skins for taxidermy or museum specimens approximates the effects of dusting by living birds. To clean skins or to dry skins that have been washed, an absorbent powder (borax, corn meal) is heaped on the skin and then shaken through the feathers (Anderson, 1948:98–99). The powder absorbs moisture, blood, and grease as it sifts through the feathers; and the mechanical action of shaking and brushing fluffs and aligns the feathers.

We speculate that dust particles absorb oil and moisture as they are shaken through the feathers. The result appears to be a drying and fluffing action. which helps keep the down from matting and maintains the insulating qualities of the plumage. Thus, dusting does improve plumage condition, and it may also help control ectoparasites. However, because of our incomplete knowledge of the function of dusting, we do not at this time recommend habitat management to provide dusting sites. We think the effects of dusting on plumage oil, and the relationships between dusting and oiling behaviors deserve more study.

Our conclusions agree closely with those of Borchelt, Eyer, and McHenry (1973) concerning dusting behavior of Bobwhite. These authors also noted an oily appearance of Bobwhite that had been deprived of dust, and they hypothesized that dust bathing serves to remove excess lipids from the plumage.

SUMMARY

Forty Japanese quail were kept on ½-inch mesh wire floors, and 40 were supplied with dusting material for 17 days. Sample feathers of dusting birds showed improved barb alignment and a decrease in dandruff. The most noticeable effect of dusting was the drying and fluffing of the down.

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